

# IPACO expert report

*Expert name*

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*Type*

**I**  
**F**  
**O**

*Class*

**A**

*Explanation*

Lens flare

*Complement*

*Document*

Photos

*Imaging location*

Saint Jean Cap Ferrat  
(06) - France

*Imaging date*

June 23, 2011; between  
10:05:33 PM and 10:09:00 PM



Photograph n°2444



*Photograph n°2445*



*Photograph n°2446*



*Photograph n°2447*



*Photograph n°2448*



*Photograph n°2449*



*Photograph n°2450*



*Photograph n°2451*



*Photograph n°2452*

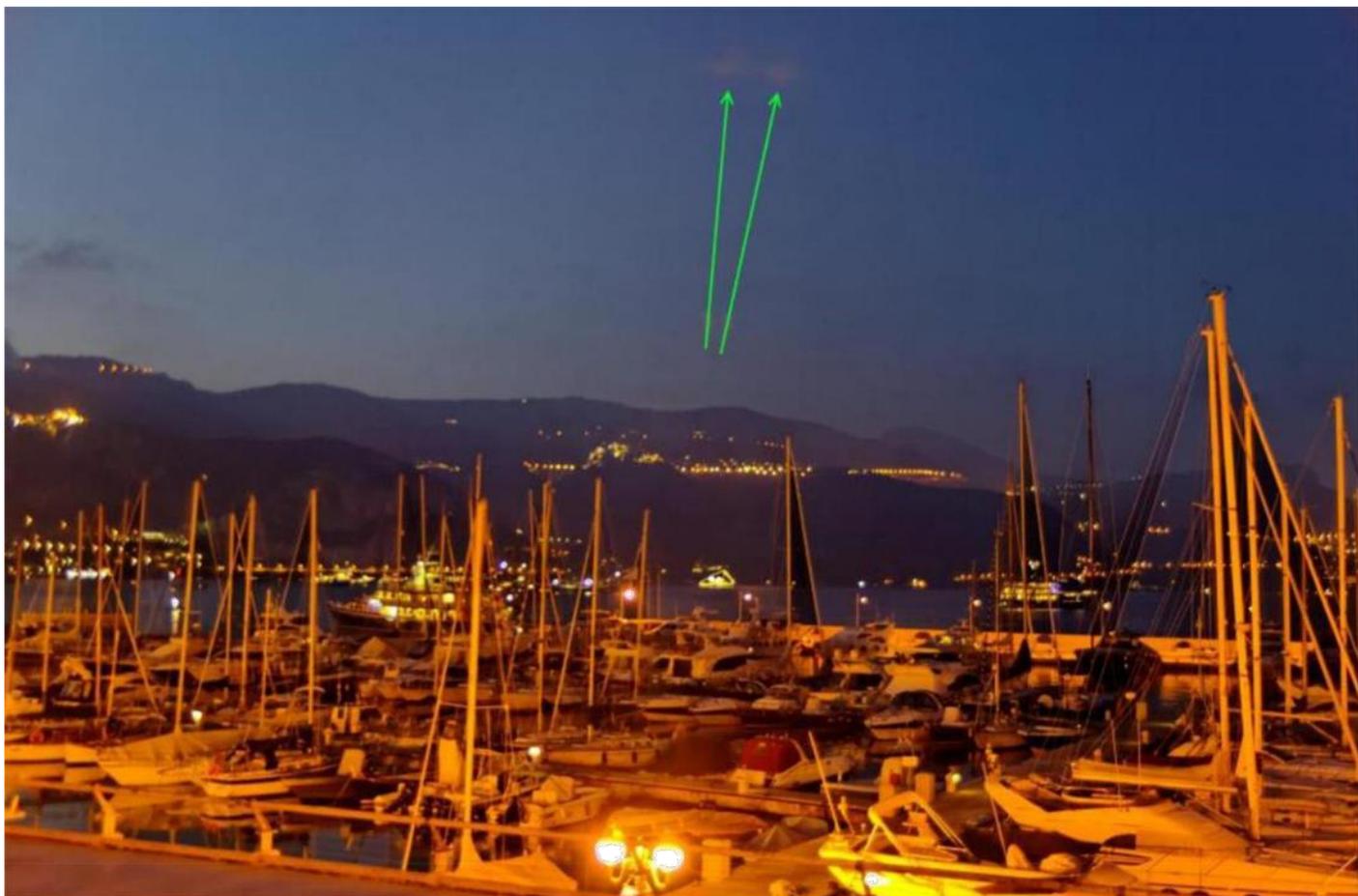
## I. Imaging circumstances

The witness was at a restaurant table and, while doing some photographs, noticed on the viewfinder of its camera « *two beams of light across the sky* ». Nothing was visible with naked eyes.

A series of images was taken, during 4 minutes.

The witness noticed as well that the visibility of the beams of lights changed depending of the camera position.

It is worth noting the presence, in addition of the beams of light, of two "*balls of light*", lying, whenever they are visible, in the axes of these beams of light:



## II. The camera

It was a Pentax K20D of which technical characteristics are shown in details [here](#).



## III. Analysis

The review of EXIF data with IPACO's authentications module does not tell us anything specific that can help in the understanding of this phenomenon.

However, a close examination of the photograph shows the presence of two bright sources of light (street-lamps) at the bottom and close to the ground.

Could these lights be the cause of the presence of the "objects" in the sky? Let's take for example photo n°2445.

With IPACO, it is possible in a simple way to define it using several tools combined into one that allows you to:

1 - Create a figure "Flare" on these lights in two clicks: the center ("1" on the following figure) and radius of a circle that approximately delimits the lights in question.

2- Finely reposition the center of this Flare figure by calculating the radiometric center of the chosen circle.

3- Materialize the Flares ("2" and "3"), in the form of an asterisk with the same radius as the chosen circle.

4 - If there is not yet any figure "Center" in the graph displayed, it creates one (Definition of the geometric center of the photograph).

5 - Draw a "diameter", i-e a straight line that passes through the flare and the geometrical center, across the entire image:

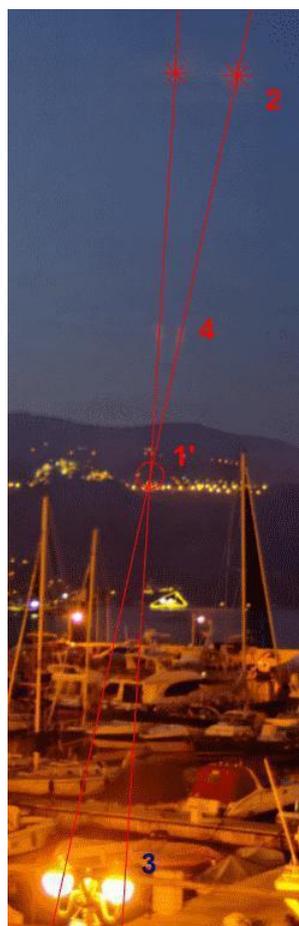


Thereby defining the geometric center of the photograph, it is found that the position of the lights in the sky is **substantially** coincident with that of the light sources, along a central axis of symmetry passing through the geometric center of the photograph.

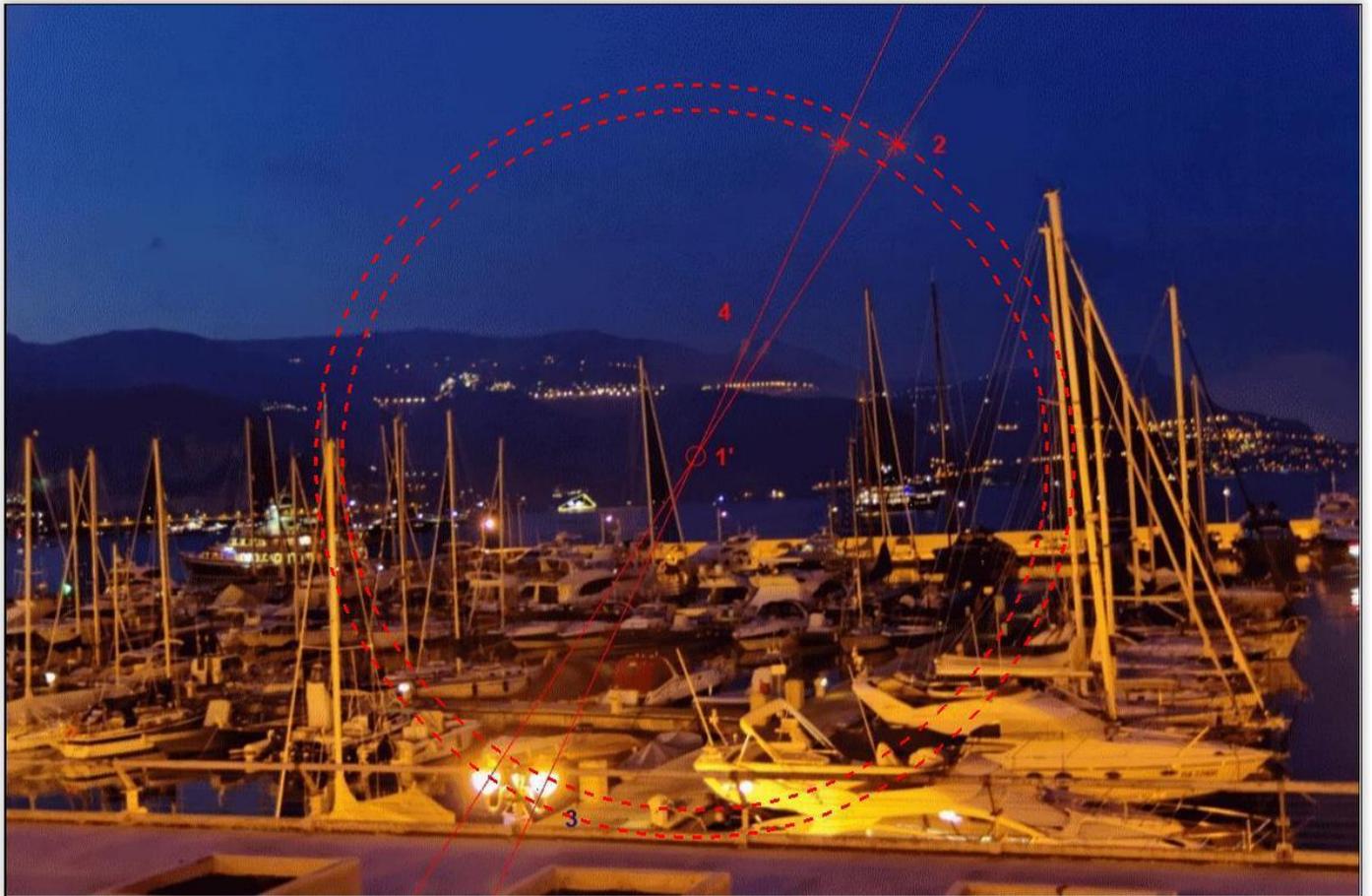
The difference is the non-exact coincidence of optical (1') and geometric (1) centers. However, it can also be compensated with IPACO whose tool "Flare" allows us to change manually the geometric center by dragging it gradually until the optical center position and thus check the consistency of the flares (see definition and technical explanations chapter V) and their light source (3, in blue):



It should be noticed that the two « *beams of light* » that originally intrigued the witness appears to exactly line up with the whole “*flare/optical center/light sources*” (4).



We can also advantageously check the existence of this alignment with other photographs; like for example the photograph n°2450:



Again, the alignment "*flare/optical center/light source*" is perfect, confirming thus that these "*objects*" are just parasitic reflections created in the internal lens system of the camera.

These reflections are always opposite to the light sources, through a central axis of symmetry materialized by the optical center of the picture.

It should be noted that it is possible to reduce or even completely eliminate these unwanted effects, either by use of a better filter quality, use of a shorter focal length, or by increasing the aperture(i-e reducing the value of the [f number](#)., keyed on the photos here to 3.5 and 5.6).

However, by far the most secure way to avoid this type of flare is to remove the filter altogether (and it's particularly true for those lacking [optical coating](#)), if any, from the lens.



## IV. Conclusion

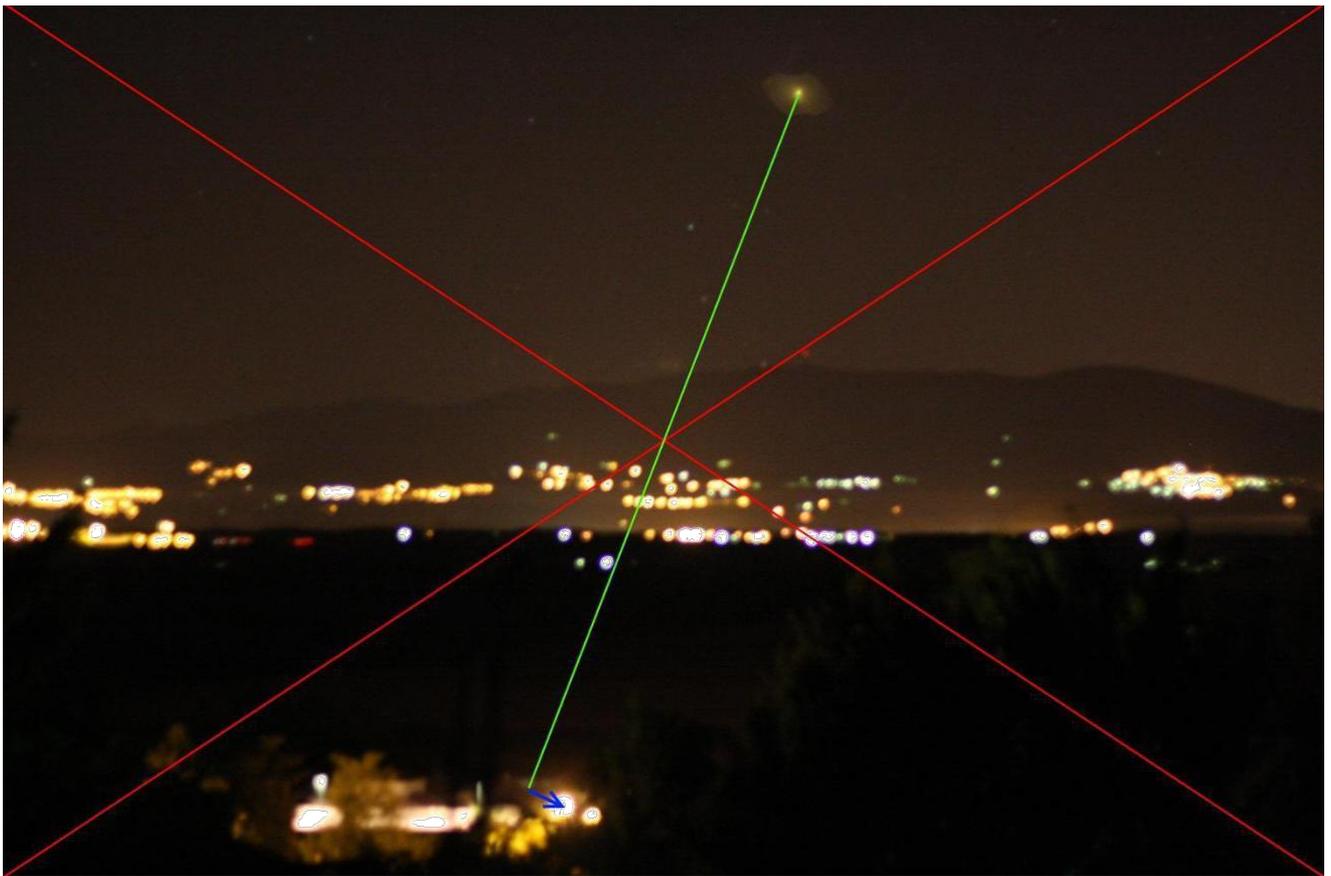
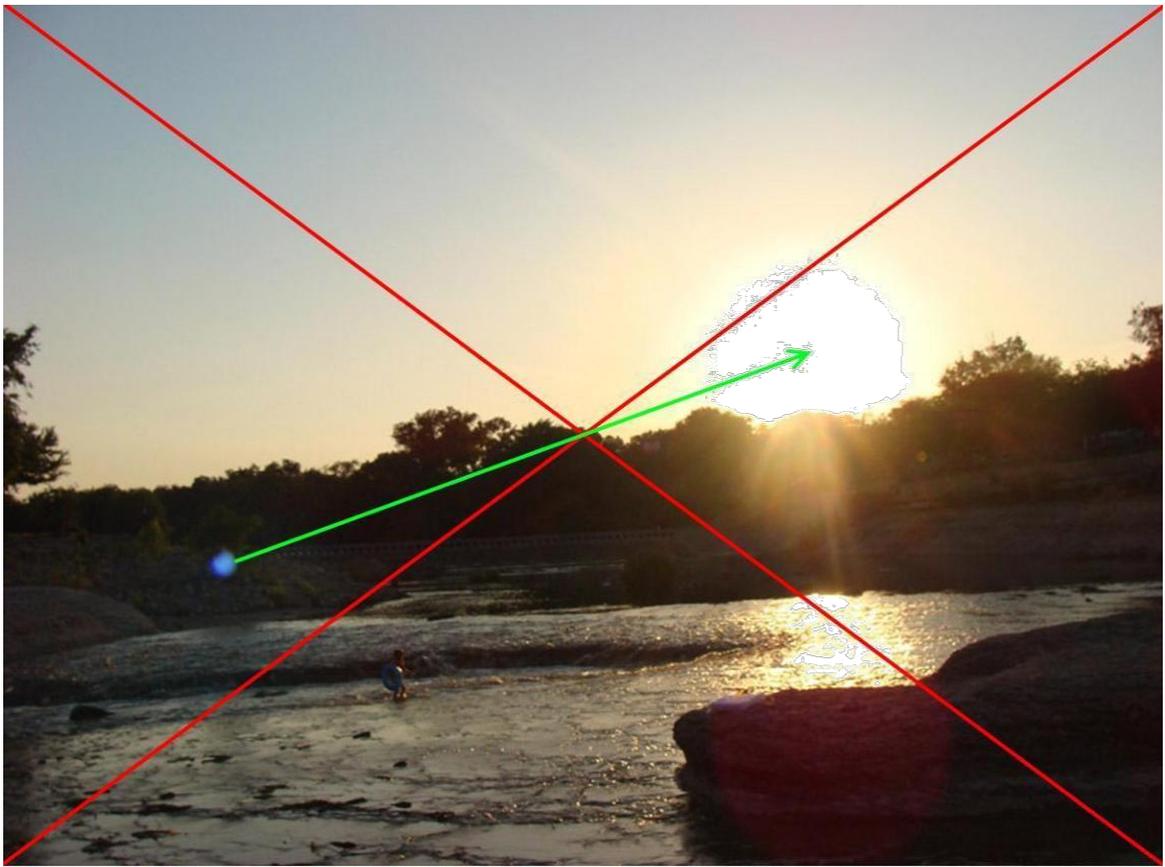
Given the objective data provided by the examination of the photographic record, we conclude that the different objects in this series of photographs are multiple light reflection parasites, also called “*flare phenomenon factor*” or simply “*lens flare*” caused by the presence of two strong light sources found in the field of photography.

## V. Technical explanation

These flares are due to the presence of a bright light source in the field of view and can be easily detected as it's a mirror ghost of the original bright object, with generally the image center serving as a point of symmetry (or [point reflection](#)).

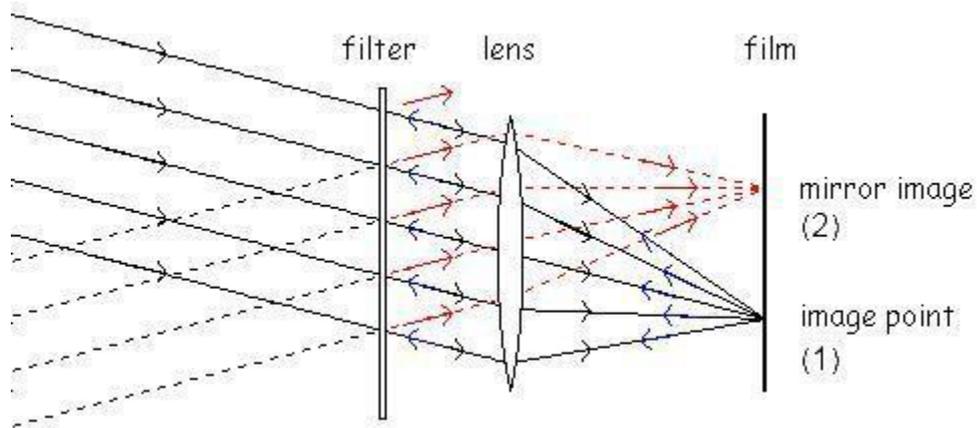


All dimensions are perfectly preserved, suggesting that the reflections on flat surfaces are responsible. Otherwise (reflections on concave or convex surfaces), it may be possible to have some differences in geometric measurements; the optical center does not coincide then with the geometrical center:



In the sketch below, black arrows indicate the light rays of a distant bright light source that form a regular image point on the film (1). Values for the reflectance of undeveloped photographic film vary from 15% to 40% [see sources 1, 2], which makes the film a much stronger reflector than any optical component in the lens.

So, a significant percentage of the light is reflected off the film, partly specular and partly diffuse.



(For convenience, we will consider that paths of the reflected light are the same and thus are already drawn for the incident light).

Thus, the **blue arrows** indicate light reflected from the film. This light encounters the filter, which specularly reflects a small fraction (**red arrows**). The red rays are parallel and consequently focused onto a point on the film. (2)

The virtual source of the mirror point is traced by the dashed black lines. Note that the blue rays reflected by the film seem odd from the viewpoint of specular reflection; they merely illustrate the fact that all light rays that originate from a single point on the film, and which are collected by the lens, emerge parallel at the filter.

## VI. Sources –photos credits

Photographs came directly from the witness.

Examples are from expert's personal collection

[1] *"SPSE handbook of photographic science and engineering"*, edited by Woodlief Thomas Jr., John Wiley & sons, p. 204 (1973).

[2] Sidney F. Ray, *"Applied photographic optics"*, 3rd ed., Focal Press, p. 139 (2002).